JPSS-1 VIIRS LAUNCH READINESS: SDR

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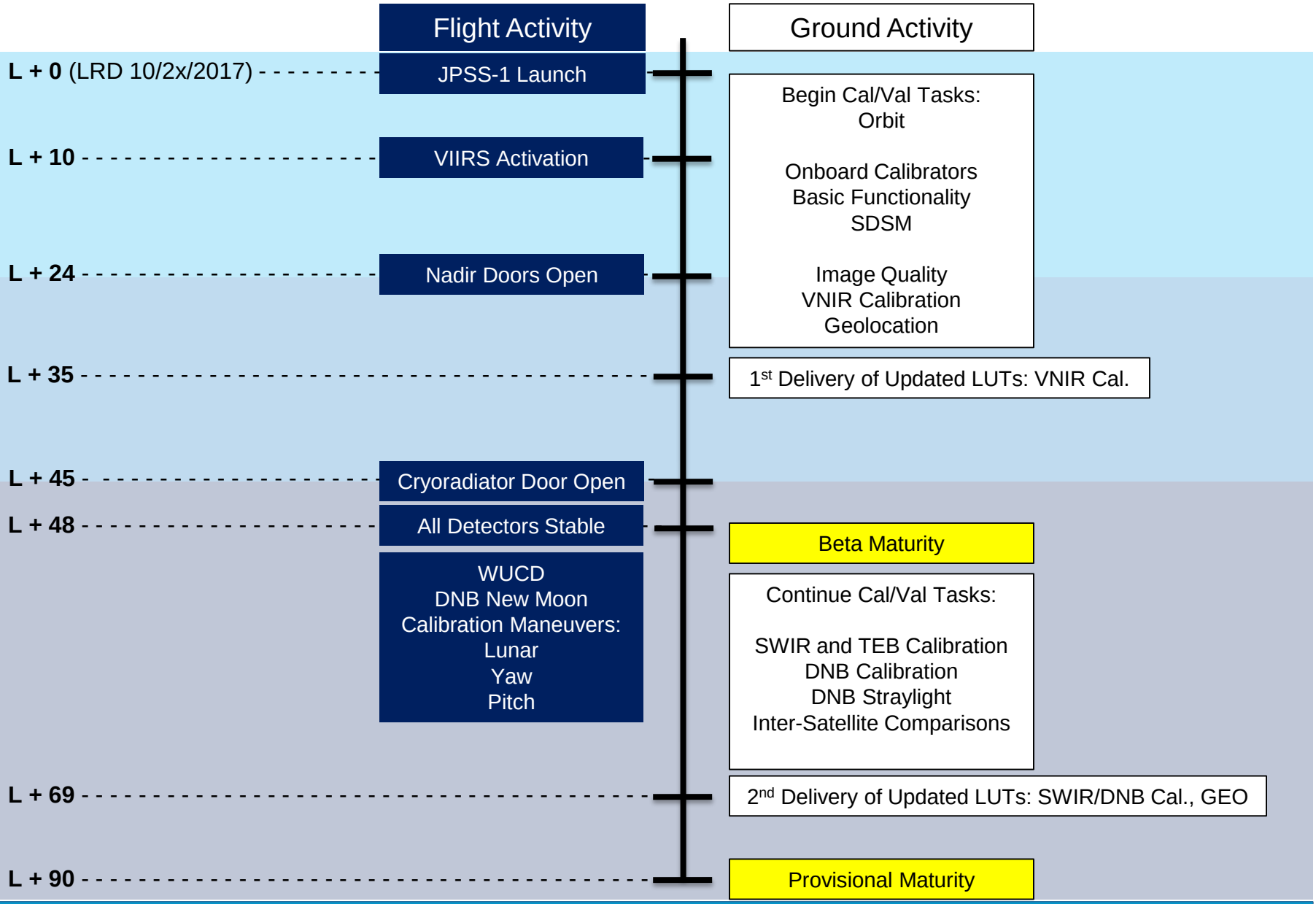
On behalf of the VIIRS SDR Cal/Val Team:

NOAA STAR, NASA VCST, Aerospace, Univ. Wisconsin

Outline

- Cal/Val Timeline
- LUT Development Summary
- SDR Production Testing
- Post-Launch Testing Preparations
- Summary

JPSS-1 VIIRS Cal/Val Timeline



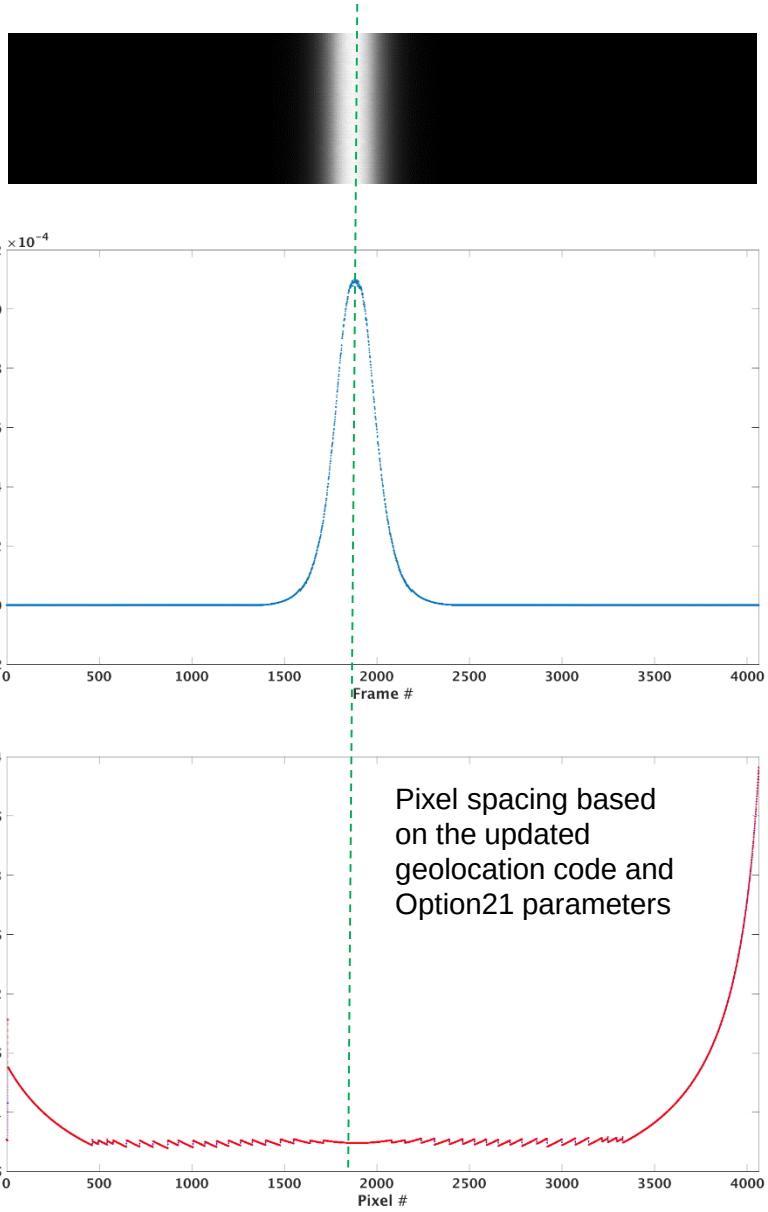
Processing Coefficients Development

- Initial prelaunch versions of 46 lookup tables (LUTs) delivered in July 2015
- 40 launch-ready LUTs delivered in July 2016 based on thorough analyses of prelaunch test data
  - More precise angular dependence of solar attenuation screens transmittance and solar diffuser bidirectional reflectance
  - Thuillier solar irradiance spectrum instead of the MODTRAN-based one
  - DNB geolocation code and parameters updated for the limited set of aggregation modes (mitigating non-linearity of DNB radiometric response)
- 4 LUTs updated in May 2017
  - VIIRS-SDR-RADIOMETRIC-PARAM-V3 revised to mitigate the incorrect “poor quality” flagging for LWIR bands due to hard-coding of the S-NPP nominal cold FPA temperature set-points (will be appropriate for any set-point selected)
  - VIIRS-SDR-DNB-DN0-LUT revised using data from the spacecraft TVAC tests to reduce risk of striping in DNB images
  - VIIRS-SDR-RELATIVE-SPECTRAL-RESPONSE-LUT revised to remove an incorrect spectral shift for band M9
  - VIIRS-RSBAUTOCAL-BRDF-SCREEN-TRANSMISSION-PRODUCT-RTA-VIEW-LUT revised based on data received from the instrument manufacturer after the previous version was generated
- 3 GEO LUTs to be updated before launch (two weeks before the Hard Freeze date)
  - If schedule allows, the LUTS will be based on post-TVAC instrument alignment measurements (otherwise – on pre-TVAC data)

SDR Production Testing

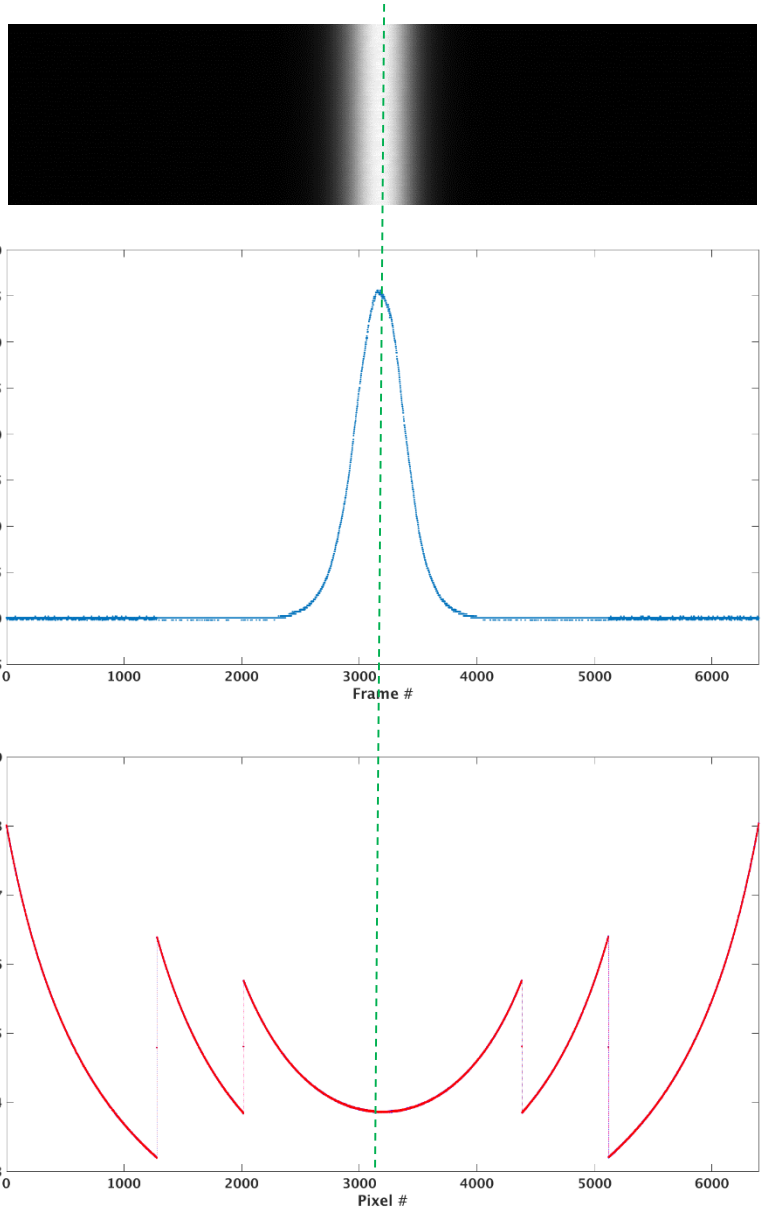
- Conducted using the latest version of the ADL software: more successful SDR production than in IDPS during JCT4, JCT5, E2E, …
- Several datasets were needed to test all SDR products:
  - Provided by the JPSS Test Data & Tools Working Group
  - **MDR28**: simulated JPSS-1 VIIRS RDR files created from the S-NPP VIIRS data acquired on January 21, 2012
  - **MDR47**: simulated JPSS-1 VIIRS RDR files created by combining actual JPSS-1 VIIRS data from the instrument thermal vacuum (TVAC) testing with S-NPP spacecraft ephemeris and attitude data acquired at the same time (no time shift required)
  - **TVAC/TVAC2**: actual JPSS-1 VIIRS RDR files created by IDPS from data acquired during JPSS-1 spacecraft TVAC and TVAC2 testing (after unsuccessful initial conversion with the direct-broadcast RT-STPS software)
- Lessons learned for JPSS-2 and beyond:
  - Share with the VIIRS SDR Cal/Val Team software used to produce MDR47
  - Improve RT-STPS software to streamline conversion of spacecraft raw data to RDR

DNB Production Testing



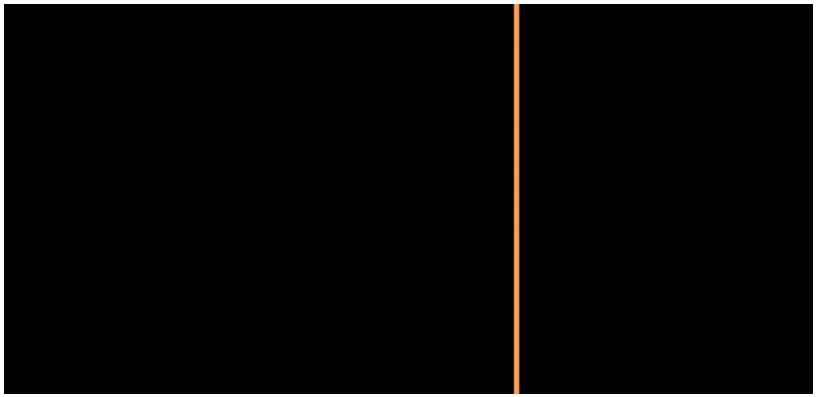
- Used ADL to process RDRs created in IDPS from the JPSS-1 Spacecraft TVAC2 data
- Artificial scene with Flat Panel Illuminator visible through the Earth View port
- Shift in the DNB nadir position consistent with the Option21 limited set of the DNB aggregation modes (1 to 21)
- Geographic location data produced based on spacecraft attitude and ephemeris data

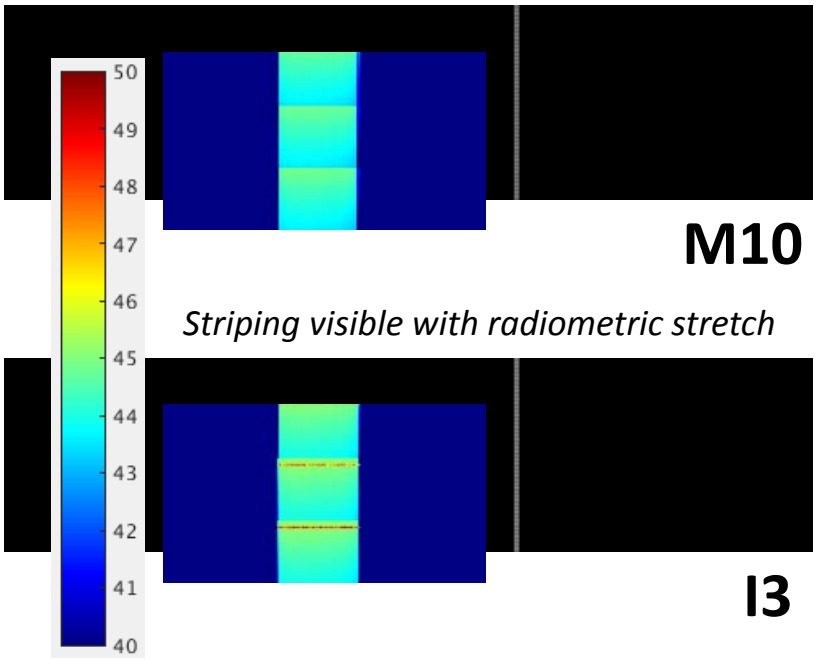
RSB Production Testing



- Used ADL to process RDRs created in IDPS from the JPSS-1 Spacecraft TVAC2 data
- Artificial scene with Flat Panel Illuminator visible through the Earth View port
  - Nadir position near center frame
  - Geographic location data produced based on spacecraft attitude and ephemeris data

RSB Production Testing

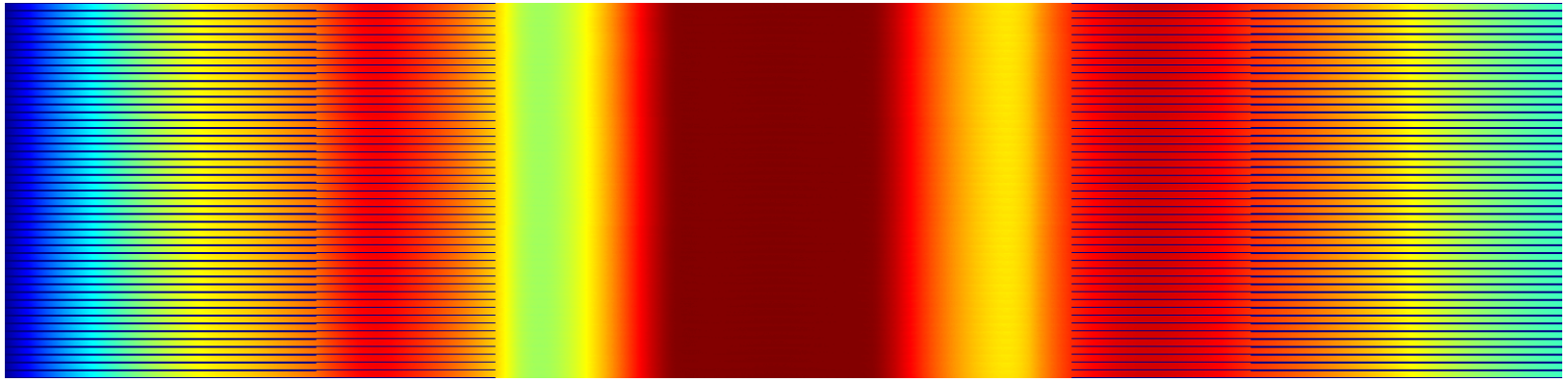




Striping visible with radiometric stretch

- Image created by the radiance data produced with ADL: bands M5-M4-M3 are shown as the RGB colors (two granules)
- MDR47 proxy RDR inputs are based on:
  - JPSS-1 VIIRS data from the instrument TVAC tests (TV-FOP, acquired during transitions between thermal plateaus, UAID 4302727)
  - S-NPP spacecraft ephemeris and attitude data acquired at the same time as the TVAC data
- Bright calibration source (TMC-SIS) placed at approx. -23° or -7° scan angle
- <10% radiometric error for the out-of-family I3 detector: difficult to calibrate because of higher noise and lower gain

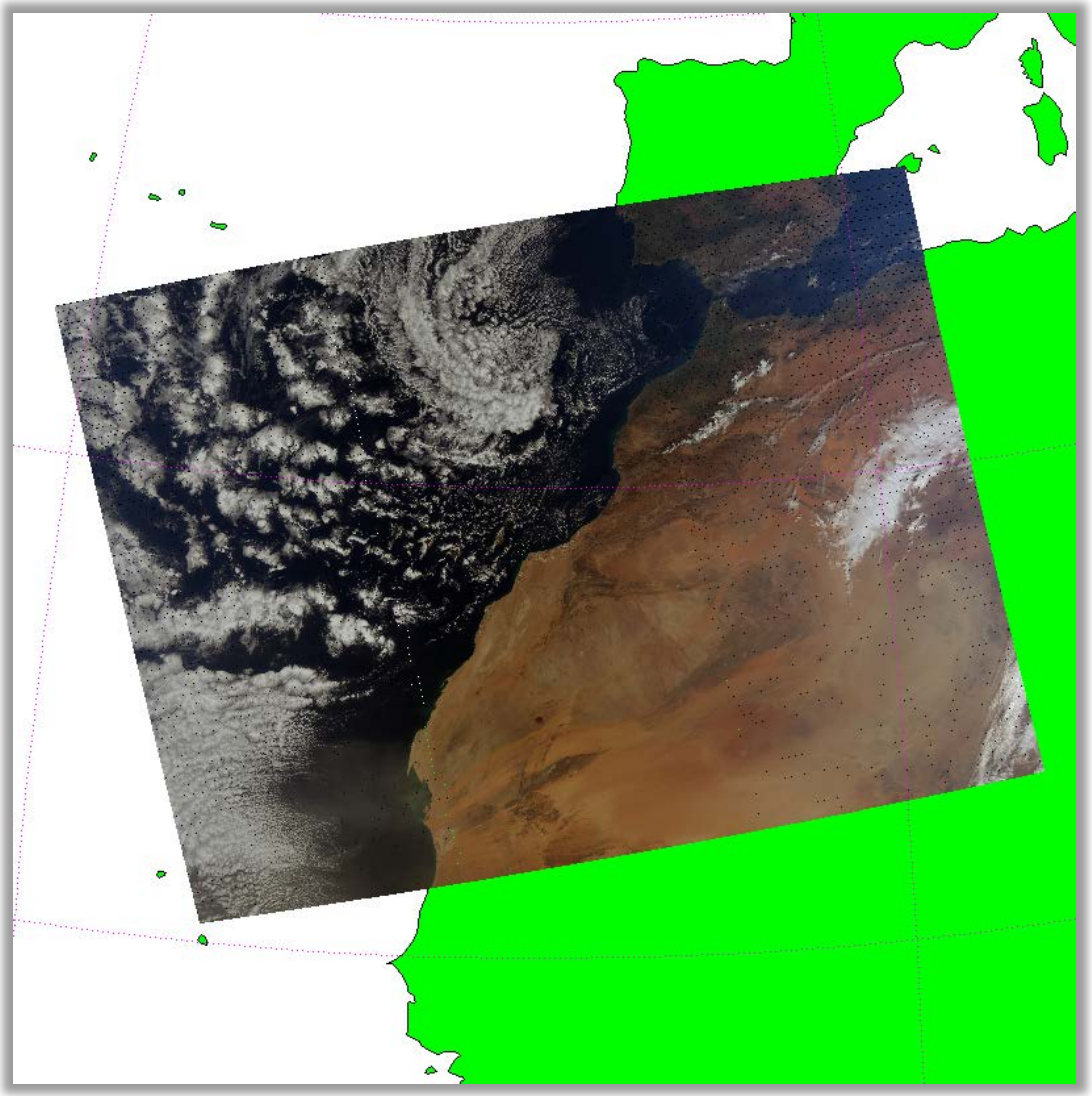
TEB Production Testing



M16 Brightness Temperature product

- Used ADL to process RDRs created in IDPS from the JPSS-1 Spacecraft TVAC2 data
- Artificial scene with Flat Panel Illuminator visible through the Earth View port: provides a dynamic input despite not being a blackbody
- Geographic location data produced based on spacecraft attitude and ephemeris data
- No “poor quality” flags with the latest LUTs

Geolocation Product Testing



- Image generated from the SDR reflectance data produced using ADL with the current JPSS-1 VIIRS GEO LUTs
- Bands M5-M4-M2 are shown as the RGB colors
- MDR28 proxy RDR inputs were created from S-NPP data
- Image projected using the terrain-corrected latitude and longitude coordinates: coastlines provide a crude test of the geolocation accuracy
- Similar results obtained during the 8-day Flight Operations testing, but with lower geolocation accuracy

4-granule aggregate: 2012-01-21 13:53.2-13:58.6 UTC, orbit 1209 (NW Africa)

Post-Launch Testing Preparations

- Identified 47 Post-Launch Test (PLT) Cal/Val tasks essential for achieving Provisional Validation 90 days after launch (L+90)
  - Divided the PLT tasks into three phases defined by the major instrument events:
    - Instrument Activation (L+10)
    - Nadir Doors Open (L+24)
    - Cryo-radiator Door Open (L+45)
  - Many tasks will start in a particular phase and then continue until the complete Validation
- Participated in development of PLT documents by the Mission Operations Support Team
- The objective is to evaluate performance, and if necessary generate adjusted LUTs for IDPS by:
  - Day L+35
    - VIIRS-SDR-F-PREDICTED-LUT (update for VNIR bands only)
    - VIIRS-SDR-DG-ANOMALY-DN-LIMITS-LUT
  - Day L+69
    - VIIRS-SDR-F-PREDICTED-LUT (update will include SWIR bands)
    - VIIRS-SDR-DNB-LGS-GAINS-LUT
    - VIIRS-SDR-DNB-DN0-LUT
    - VIIRS-SDR-DNB-GAIN-RATIOS-LUT
    - VIIRS-SDR-DNB-STRAY-LIGHT-CORRECTION-LUT
    - VIIRS-SDR-GEO-DNB-PARAM-LUT
    - VIIRS-SDR-GEO-IMG-PARAM-LUT
    - VIIRS-SDR-GEO-MOD-PARAM-LUT

PLT Cal/Val Tasks

Tasks Starting After Instrument Activation

Task ID	Title
GEO-1	Initial Validation of Spacecraft Ephemeris and Attitude Data
GEO-2	Initial Validation of VIIRS Encoder Data, Scan Time, Scan Period, and Scan Rate Stability
FPF-2	Detector Operability and Noise Verification with Nadir Door Closed: RSB VNIR, DNB
FPF-6	DC-Restore Functionality and Performance Check
FPF-7	Calibrator Visual Inspection
PLT-X	DNB Straylight with Nadir Doors Closed (using sector rotation)
CSE-1	SD and SDSM Characterization
CSE-2	Onboard Calibrator Black Body (OBCBB) Temperature Uniformity
CSE-4	Temporal Analysis of SD Signal over Polar Region
CSE-5	Temporal Analysis of Solar Diffuser Stability Monitor (SDSM) Data
PTT-1	Operability, Noise, SNR Verification
PTT-6	Telemetry Trending Monitoring
PTT-10	RSBAutoCal Calibration Object Trending, Evaluation & LUT Updates

- Reviewed plans for the PLT Cal/Val tasks data analyses
- Began conducting rehearsals and reviewing readiness of all tools necessary to conduct the tasks
- Planning to update RDR Toolkit to accommodate new DNB APIDs for the HGA/HGB stages

Tasks Starting After Nadir Doors Open

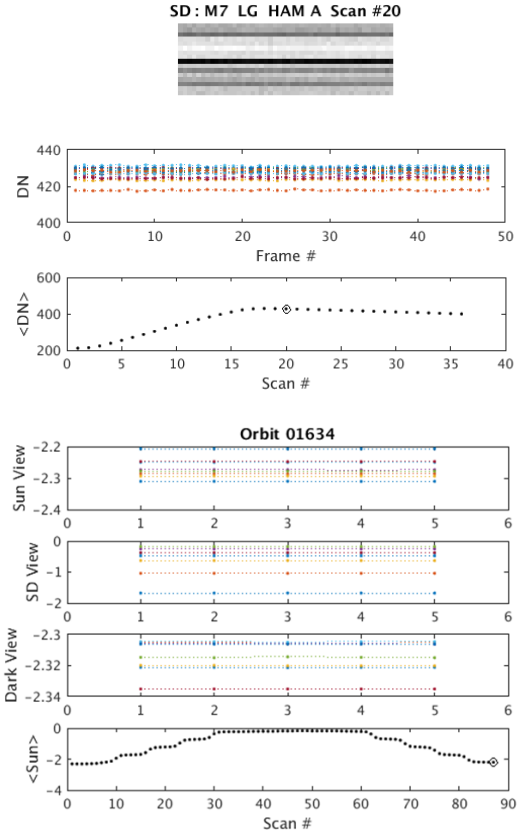
Task ID	Title
FPF-3	In-Scan Aggregation Verification – non-DNB bands
FPF-4	Dual Gain Band and DNB Transition Verification
FPF-5	On-Board Bow-Tie Deletion Verification
CSE-3	Earthshine Contamination of Solar Diffuser Data
IMG-1	Crosstalk, Echo, and Ghost Investigation
IMG-2	Image Analysis (Striping, Glints and Other Artifacts)
RAD-3	Dynamic Range and Linearity
RAD-4	Response vs. Scan Angle (RVS)
RAD-7	SDR Comparison with SNPP-VIIRS
RAD-8	SDR Comparison with MODIS
RAD-8'	SDR Comparison with AVHRR
GEO-3	Assess Reasonableness of First- Period SDR Geolocation
GEO-4 to 7	Analyze First-Period VIIRS GCP Residuals
GEO-9	Develop and Test Initial Geolocation LUT Updates
PTT-2	RDR Histogram Analysis
WAV-1	J1 DNB aggregation mode verification
WAV-2	J1 DNB geolocation vs. aggregation zone

Tasks Starting After Cryoradiator Door Open

Task ID	Title
IMG-3	Moon Echo and Ghost Check
CSE-6	Yaw Maneuver Analysis
RAD-1	Out-of-Band (OOB) Spectral Leakage
RAD-2	Crosstalk from Emissive Bands to Reflective Bands
RAD-6	SDR Comparison with Model
RAD-9	RSB Radiance/Reflectance Validation – Radiometric Sites
RAD-10	Brightness Temperature Validation Using Buoy Data
RAD-11	In-Band Spectral Radiance Comparison with CrIS
RAD-14	Emissive Band Response Characterization (WUCD)
RAD-15	Moon in Space View Correction
RAD-18	Lunar Data Analysis - Roll Maneuver
RAD-19	Analysis of Pitch Maneuver Data
RAD-20	SDR Reprocessing and Updates
RAD-23	Dual Gain Band Anomaly Analysis
RAD-24	Offline F/H Factor Analysis, Prediction and Validation Tool
PTT-4	DNB Offset Verification
WAV-4	J1 DNB straylight assessment and correction LUT development

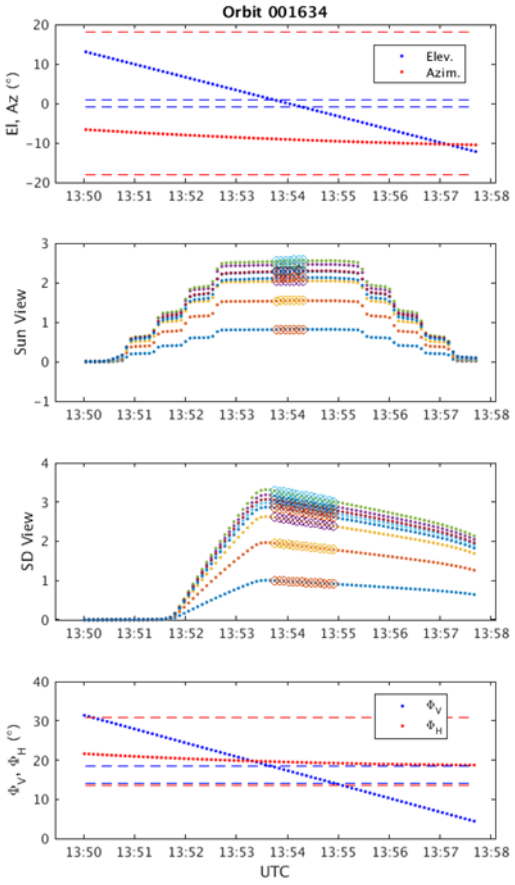
Cal/Val Tasks Rehearsals

FPF-7: Calibrator Visual Inspection

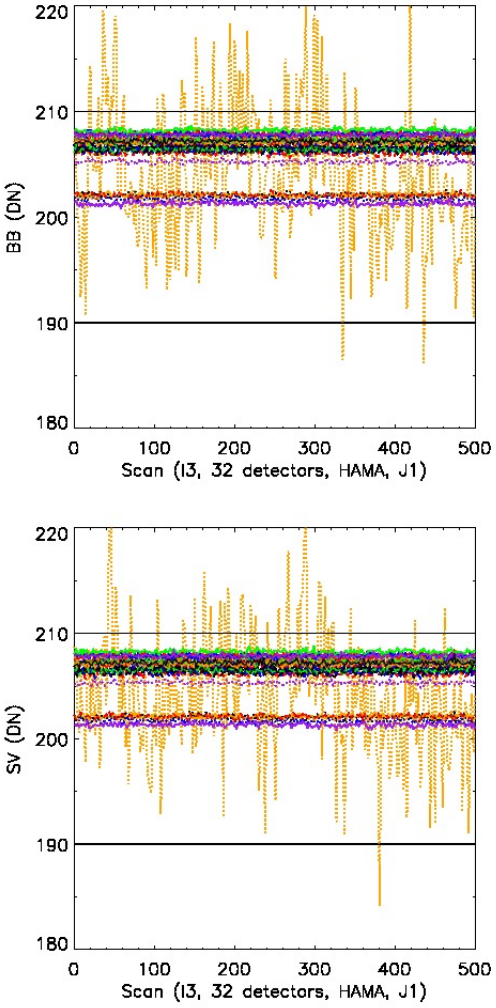


SDSM 5 Samples Consistency

CSE-1: SD and SDSM Characterization

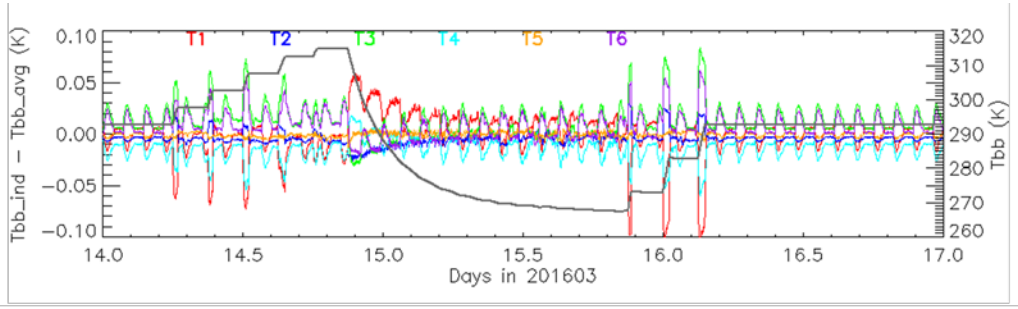


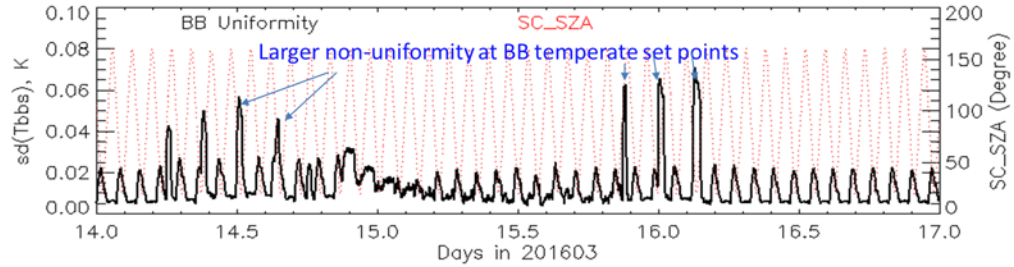
FPF-6: DCR Functionality Check



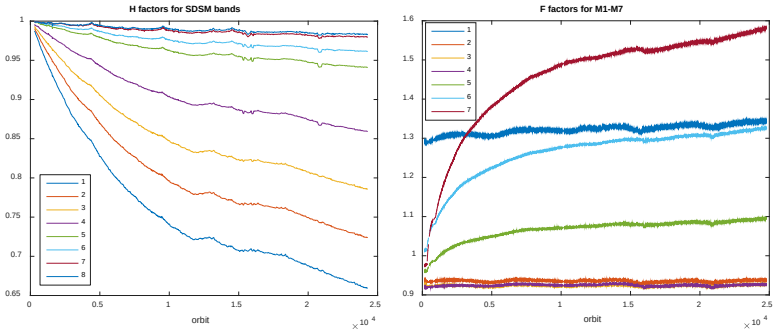
Cal/Val Tasks Rehearsals

CSE-2: OBC BB Temperature Uniformity

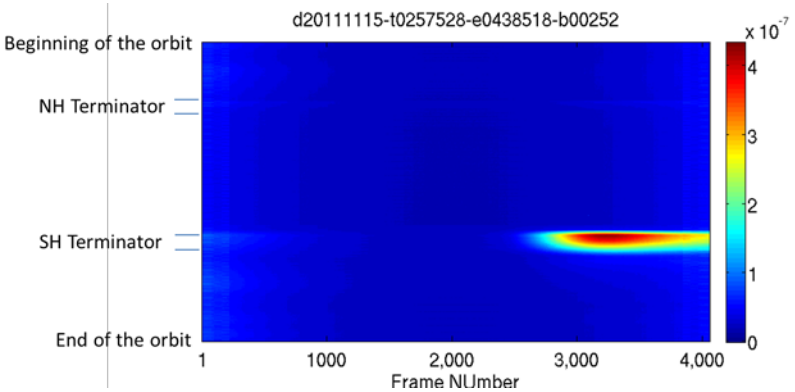




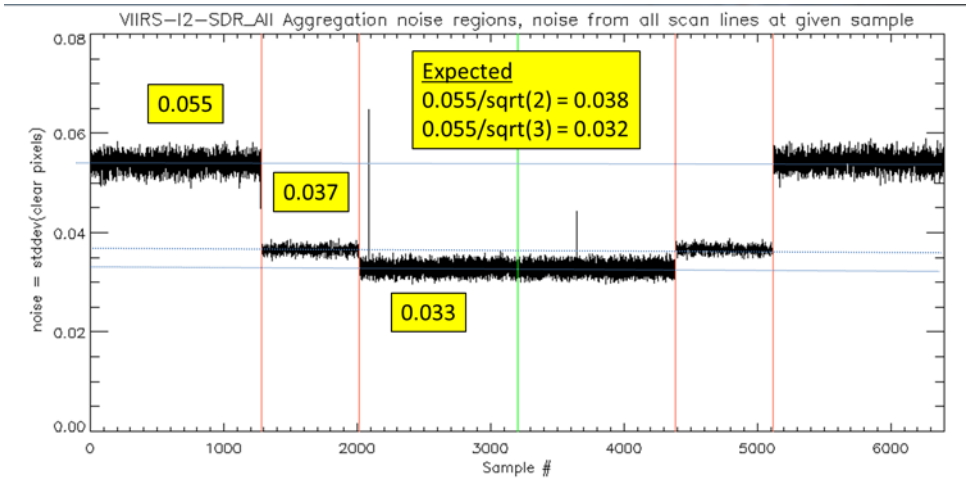
RAD-24: Offline F/H Factor Analysis, Prediction and Validation



PLT-X: DNB Stray Light with Nadir Doors Closed



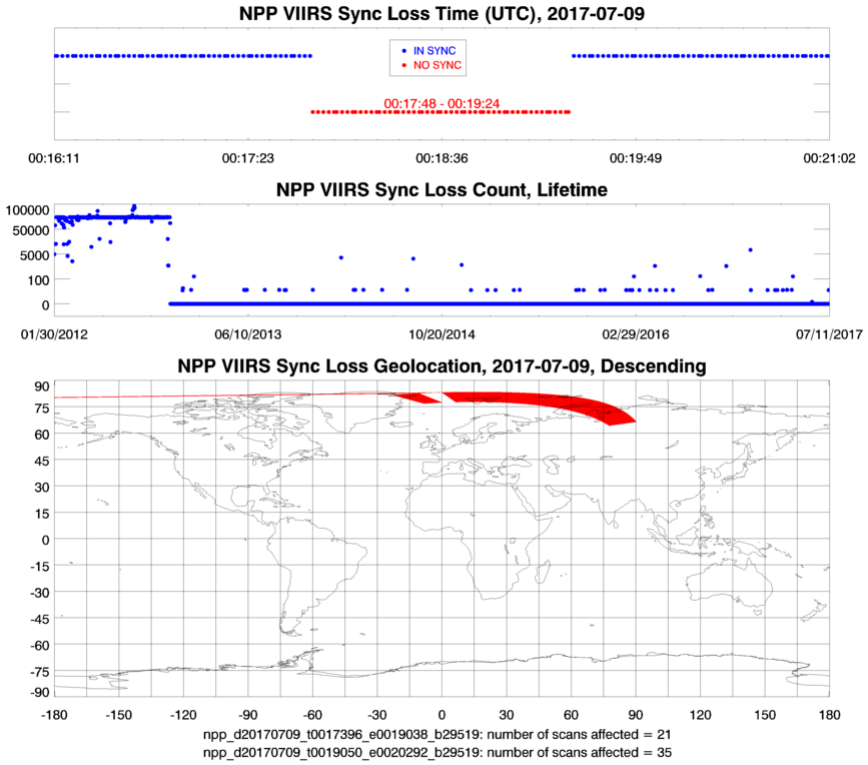
FPF-3: In-scan Aggregation Verification

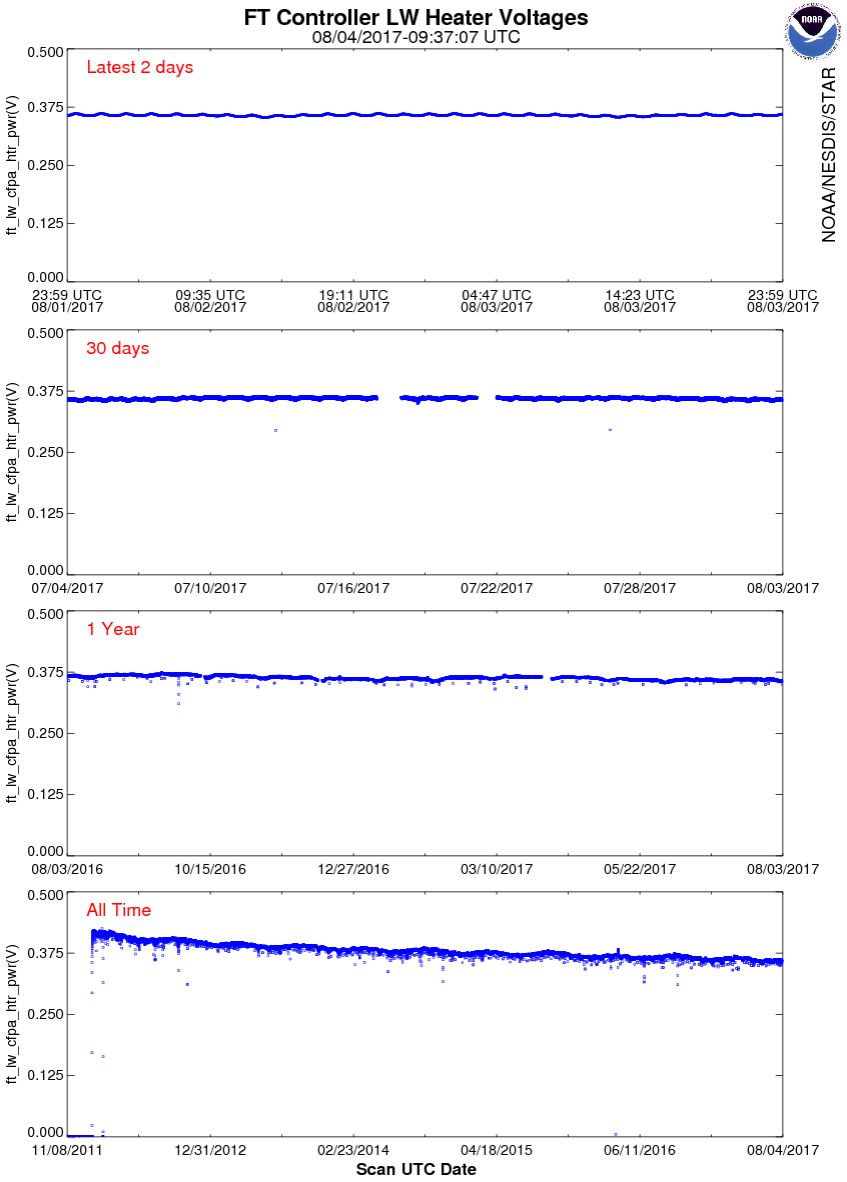


Cal/Val Tasks Rehearsals

PTT-6: Telemetry Trending Monitoring

- Provided by the NOAA STAR ICVS system
- Enables tracking vital instrument parameters to assess sustainability of VIIRS SDR products, e.g., ability to maintain TEB detector temperature





Summary

- All LUTs needed for JPSS-1 VIIRS SDR production delivered
  - GEO LUTs still to be updated based on latest instrument alignment measurements
- All SDR products generation successfully tested – detected issues corrected or mitigated
- Plans for post-launch Cal/Val tasks reviewed and updated: rehearsals of data analyses started
- VIIRS SDR Cal/Val team ready for the JPSS-1 launch